Amendments to the Specification

Please replace the paragraph beginning at page 9, line 24, with the following rewritten paragraph:

Referring to Fig. 4, a point contact solar cell is schematically portrayed in general at 26. Cell 26 is fabricated in a silicon die ~~10~~ 28 with two opposing major surfaces with the surface area being on the order of $4mm^2$. The die ~~10~~ 28 is an intrinsic monocrystalline silicon chip. A pattern of p+ doped regions 30 and n+ doped regions 32 are formed in one surface in a repetitive pattern of interleaved rows. The p+ rows and the n+ rows are interconnected to form the contacts for the solar cell. A repetitive pattern is derived for the diffused regions, with each pattern or cell separated from adjacent cells by streets or space for eventual sawing of the substrate and forming of individual dies. Prior to the cell fabrication in the substrate, dopant is diffused through the substrate 28 in the channels, thereby forming passivation regions as represented at 34. See generally U. S. Patent No. 6,333,457 (supra).

Please replace the paragraphs beginning at page 10, line 6, with the following rewritten paragraphs:

An initial aspect of the present invention resides in the improvement of the absorption efficiency of VMJ type cells as at 14. Referring to Fig. 5, a multijunction photovoltaic cell is represented in general at 40. Cell 40 is schematically represented as having a series connected array of junction unit cells certain of which are shown at 42. These series arrayed cells 42 are, as before, interconnected between oppositely disposed terminals 44 and 46. Solar energy is represented at arrow 48 again impinging upon a multijunction defined edge illumination receiving surface 50. Note, however, in the instant embodiment the stack orientation of the cells 42 is disposed at a stack angle with respect to the plane of its illumination receiving surface. This stack angle is represented at α in Fig. 5A. Preferably the angle, α, is Brewster's angle ~~value the which~~ the value of which will be dependent upon the indices of refraction involved. However, a variety of stack angles can be employed to improve photon absorption efficiency by encouraging internal reflection and resultant depletion layer/photon interaction activity. In general photocell 40 is referred to as an "angle multijunction cell" (AMJ).

Now looking to the aspects of heat generation by the multijunction cell arrays, it may be observed that the sun may be considered to be a black body radiating at about 5800° Kelvin (at earth). In general, radiation may be considered in terms of energy per wavelength, following the Planck curve of emission of light. Looking to Fig. 6, such a Planck curve is schematically represented at 60. In general, the curve 60 relates electrical energy to wavelength energy following Planck's formula which may be represented as follows:

$$E = \overline{h} / \lambda$$

~~where is Planck's~~ where $\bar{h}$ is Planck's constant divided by 2π. In general, the ordinate of curve 60 may be represented as energy per wavelength or watts/(m^2 x nm) and the abscissa represents wavelength in nanometers. In general, Planck's formula represents that, as wavelengths become smaller, the energy in the associated photons grows greater. However, bandgap energy remains constant. It may be further observed that the circuit associated with a given photovoltaic cell can absorb bandgap energy. For silicon devices, that bandgap energy (BGE) is present at ~~the~~ 1100 nanometers as represented by vertical dashed line 62 in the figure. Accordingly, for such devices, the energy represented at longer wavelengths and illustrated in crosshatched fashion at 64 is too weak and is manifested within the photovoltaic device as heat.

Please replace the paragraphs beginning at page 11, line 6 with the following rewritten paragraphs:

On the other hand, as the wavelength shortens, photon energy increases and photons which may be absorbed in the depletion layer to contribute to electrical production will fall below internal dashed curve 66. Note that curve 66 somewhat peaks at one-half the value of wavelength representing bandgap energy at dashed line 62. This halfway point is represented at vertical dashed line 68 which extends from 550 nanometers wavelength. ~~Halting~~ Halving that wavelength again results in a 275 nanometer wavelength represented at vertical dashed line 70. As is apparent, between vertical dashed lines 68 and 70 very little useful energy is available for the generation of electrical output, photons, in effect, being transmitted through the ~~photovoltic~~ photovoltaic device to create heat. Hatched areas 72, 74, and 76 ~~and 78~~ reveal very little effective depletion layer generated energy. In accordance with the

method of the invention, the wavelengths between bandgap energy line 62 and about one-half of the associated wavelength at line 68 is considered a band of useful wavelengths. In this regard, while that region contains non-usable photon energies as represented at hatched region 72, by restricting operation of the photocell in effect between lines 62 and 68, a substantial amount of heat generation energy is avoided. In effect, a "spectral cooling" can be achieved. The method of the invention will be seen to remove components of solar energy at a concentration light path which corresponds with at least a portion of those wavelengths substantially ineffective to evoke cell electrical output. With the arrangement, greater concentration of sun radiation may be employed in the generation of electrical energy by virtue of this spectral cooling approach.

A variety of approaches can be utilized for the removal of ineffective solar energy components (ISEC) as represented at cross hatch curve regions 64, 70, 72, 74 and 76. For example, dichroics, either reflective or transmissive may be employed. Additionally, frequency shifting may be carried out with luminescence, phosphorescence or fluorescence. Considering conventional heat sinking constraints as described above, electricity generation efficiencies can alter from about a conventional 10% of useful energy to about 70% of useful energy

Please replace the paragraph beginning at page 13, line 23, with the following rewritten paragraph:

Focusing an image of the sun through a dichroic system or the like directly into the receiving surface of the photovoltaic array is problematic. In this regard, as the primary concentrator tracks, difficulties arise as a sun image is formed for photocell operation. Of particular importance, direct ~~imagining~~ imaging at the receiving surface will result in an uneven intensity distribution wherein electrons produced in conjunction with the bright spot will migrate to darker regions and not be available as an electrical output. It is therefore desirable to provide a Lambertian distribution across the entire photovoltaic cell receiving surface.

Please replace the paragraph beginning at page 14, line 18, with the following rewritten paragraph:

Referring to Fig. 11, the system and method now ~~is~~ are illustrated in conjunction with the non-imagining homogenization of the corrected concentration

light path. In the figure, incoming solar radiation is represented at arrow 210 extending to a concentrator 212 such as a parabolic mirror or the like. Concentrator 212 conventionally will be associated with a tracking function as represented at block 214 and arrow 216. The result of this concentration is a concentration light path as represented at arrow 218. This concentration light path then is treated as represented at block 220 by removing ineffective solar energy components (ISEC). Thus treated, a corrected concentration light path is evolved as represented at arrow 222. Corrected concentration light path 222 then is subjected to ~~non-imagining~~ non-imaging homogenization as represented at block 224 which, in effect, derives a Lambertian distribution. A corrected homogenized concentration light path then is evolved as represented at the arrow array shown generally at 226. That corrected homogenized concentration light path is then directed to the receiving surface of a series coupled photovoltaic cell array represented at block 228. In addition to spectral cooling, as represented at block 230 and arrow 232 heat sinking additionally may be employed in conjunction with the cell array 228. A d.c. output then is directed from the cell array as represented at arrows 234-238. Arrow 235 is seen directed, as an option to a d.c. implemented energy conversion load 240 as described earlier. Arrow 236 is directed to block 242 providing for the optional distribution to d.c. storage systems as a load. The d.c. input at arrow 237 is directed to an inverter function as represented at block 244 which, as represented at arrow 246 and block 248 provides an a.c. output for driving an a.c. load. The d.c. input at arrow 238 also is directed to an inverter as represented at block 250, the a.c. output of which, as represented at arrow 252 and block 254 concerns the option of a.c. storage systems.

Please replace the paragraph beginning at page 17, line 24, with the following rewritten paragraph:

The spectral cooling features of the invention may be applied to multi-spectral systems wherein multi-junction cell arrays are provided at discrete locations and are formulated utilizing a combination of Periodic III-V semiconductor materials to capture an expanded range of photon energies and enhance the overall efficiency of the solar conversion systems. Referring to Fig. 17 a Planck curve again is represented schematically at 400. For exemplary purposes, curve 400 is associated with vertical dashed lines each representing bandgap energy for one of the multi-

spectral configurations of photo cells. In this regard, note that a germanium, (Ge) bandgap energy line is represented at 402. Low energy and heat creating photon interaction are represented at wavelengths above that at line 402 as represented by hatched area 404. On the other hand, a useful band of wavelengths may be represented at area 406 which extends to vertical dashed line 408 corresponding with an exemplary silicon based multijunction photocell array. Only that region of the curve represented at hatched portion 410 will be unused ~~and~~ as heat generating ~~photo~~ photon energy. Note that the bandgap energy line 408 for silicon resides at the terminus of the germanium wavelength band of useful energy. The silicon wavelength band of useful energy is present at region 412 having a lower terminus at bandgap energy dashed line 414. Line 414 corresponds with the bandgap energy wavelength of a gallium arsenide (GaAs) structured photovoltaic cell. Energy which will be converted to heat with respect to the silicon photovoltaic structure performance is represented at the hatched region 416. The gallium arsenide wavelength band of useful energy is represented at region 418 extending to vertical dashed line 420 representing the bandgap energy of an indium phosphide (InP) structured photovoltaic cell array. That energy which converts to heat within that useful bandwidth 418 is represented at hatched area 422. In similar exemplary fashion, the wavelength band of useful photon energy for a photocell array structured of indium phosphide is represented at region 424, while the corresponding region within that wavelength band generating heat is represented at hatched area 426. As is apparent, the dichroic system which derives spectral cooling for the multi-spectral photovoltaic cell components is one rejecting light wavelengths of upwardly increasing values while accepting values lower than the wavelength representing bandgap energy.

Please replace the paragraph beginning at page 18 line 21, with the following rewritten paragraph:

Referring to Fig. 18, a dichroic separation system corresponding with the exemplary arrangement of Fig. 17 is presented. In the figure, a spherical primary concentrator mirror is represented at 430 in conjunction with ray traces 432 and 434. As described in connection with Fig. 15, traces 432 and 434 image a coma and, thus, a coma corrector lens 436 is provided at the image plane of mirror 430. Ray traces from corrector lens 436 are represented at 438 and 440. These traces first

encounter dichroic mirror or reflector represented symbolically at 442 which, assuming the arrangement of Fig. 17 diverts photon energy which is bandgap matched, for example, to a germanium structured photovoltaic cell array represented symbolically at 444. Similarly, a dichroic device which is bandgap matched to a silicon based photovoltaic cell array is next presented in sequence, the latter array being symbolically represented at block 446. Next, a dichroic device 448 which, for example, is bandgap matched to a ~~galley of~~ gallium arsenide structured photovoltaic photocell array is represented in conjunction with the latter array as represented symbolically at block 450. Finally, a dichroic device represented symbolically at 452 may divert a useful wavelength ~~bands~~ band to a bandgap matched photovoltaic cell array structured, for example, of indium phosphide as represented symbolically at block 454.

Please replace the paragraph beginning at page 19 line 4, with the following rewritten paragraph:

Referring to Fig. 19 a flow diagram of one approach to the multi-spectral systems symbolically discussed in connection with Fig. 18 is presented. In the figure, solar radiation is represented at arrow 460 in conjunction with a light concentrator represented at block 462. Concentrator 462 may be associated with suntracking features as represented at block 464 and arrow 466. A concentration light path is represented at arrow 468 extending to block 470. Block 470 represents a function providing for the separation of the concentration light path into 1 through N spectrally defined light paths with removal of ineffective solar energy components (ISEC). In consequence, N corrected concentration light paths are created as represented by the arrow array identified generally at 472. Each of the N corrected concentration light paths then is directed to a light homogenization function as represented at homogenization block array shown generally at 474 to provide N corrected homogenized concentration light paths as generally identified at arrow 476. Each of the N corrected homogenized concentration light paths is directed to a bandgap energy matched series coupled photovoltaic cell array. These cell arrays as numbered one through N, are represented at respective blocks 478-481. As before, the photocell arrays are associated with a heat sinking function as represented at block 484 and respective arrows 486-489. The d.c. outputs of the photovoltaic cell arrays are collected or combined as represented by arrows 490-

494. Because the d.c. levels will typically be different, their collection must be accommodated for. For example, this collection may be carried out with a peak power detecting and collecting circuit. Optionally, the outputs can be ~~invented~~ inverted and directed to discrete inputs to the core of the primary side of a transformer and then rectified. This collection and peak power tracking is represented at block 496. The d.c. output from the function of block 496 is represented at arrows 498-502. The noted optional, transformer based collection approach is illustrated in phantom in the figure. In this regard the outputs at arrow 494 are directed, as represented at arrow 520 and block ~~522~~ 521 to an inverter function. The outputs from the inverter function ~~522~~ 521 at arrow ~~524~~ 522 are directed to discrete components of the primary side of a transformer represented at block ~~526.~~ 523. A collected a.c. output then is produced at arrow ~~528~~ 524 and then rectified as represented at block ~~530.~~ 525. The rectified output then is ~~convened~~ conveyed to arrow 498[[.]] as shown at arrow 526. As before, as represented at arrow 499, one potential use of the d.c. output is into a d.c. implemented energy conversion load represented at block 504. Another utilization may be an introduction to d.c. storage systems. As represented at arrow 500 and block 506, the d.c. output may be inverted as represented at arrow 501 and block 508, whereupon as represented at arrow 510 the a. c. output may be directed to an a.c. load as represented at block 512. As another approach, as represented at arrow 502 and block 514, the d.c. output may be inverted to provide an a.c. input to a.c. storage systems as represented at arrow 516 and block 518.

Please replace the paragraph beginning at page 20, line 9, with the following rewritten paragraph:

The spectral separation described in connection with block 470 may be implemented in the primary concentrator itself. Referring to Figs. 20 and 20A a Fresnel implemented primary concentrator is schematically represented in general at 530. The exploded view of Fig. ~~28~~ 20A reveals that the concentrator 530 is formed of a sequence of four transparent Fresnel mirror structures represented generally at 531-534. Structure 531 is configured with a transparent Fresnel pattern 531a, a flexible dichroic membrane 531b and a complimentary transparent Fresnel mirror pattern 531c. Structure 531c may be considered the negative or reverse version of pattern 531a and functions to support the flexible dichroic membrane 531b such that

is assumes and provides a dichroic mirror function with respect to the inwardly disposed etalon components of lens 531a.

Please replace the paragraph beginning at page 21 line 6, with the following rewritten paragraph:

The removal of ineffective solar energy components (ISEC) as well as separation of the concentration light path into bandgap energy matched series coupled photovoltaic cell arrays also can be carried out with transparent parabolic primary concentrator structures which are treated with a dichroic component and which are slightly offset. Such an arrangement of color selective mirrors is schematically illustrated in Fig. 21. In the figure, parabolic ~~dichroic component~~ structure 570 is seen to be associated with ray traces 572 and 574 which extend to a focal point at the entrance of secondary concentrator and associated bandgap energy matched series couple photovoltaic cell array as represented generally at 576. Parabolic dichroic reflector and primary concentrator 578 also removes ISEC components and is offset from dichroic primary concentrator 570. In this regard, ray traces 580 and 582 extend from the dichroic treated primary concentrator 578 to a focal point at the entrance of secondary concentrator and associated bandgap energy matched series coupled photovoltaic cell array as represented generally at 584. Lastly, a parabolic primary concentrator 586 is seen to be displaced from both primary concentrators 578 and 570. The concentrator 586 additionally is configured with dichroics to effect removal of ISEC. The offset primary concentrator is seen having ray traces 588 and 590 extending therefrom to a focal point at the entrance of secondary concentrator and associated bandgap energy matched series couple photovoltaic cell array as represented generally at 592. It may be noted that the secondary concentrators as described in connection with Figs. 20 and 21 also may be configured ~~with~~ both as homogenizers and for additional ISEC removal. Such removal is indicated in the figures by the presence of heat sinking fins.